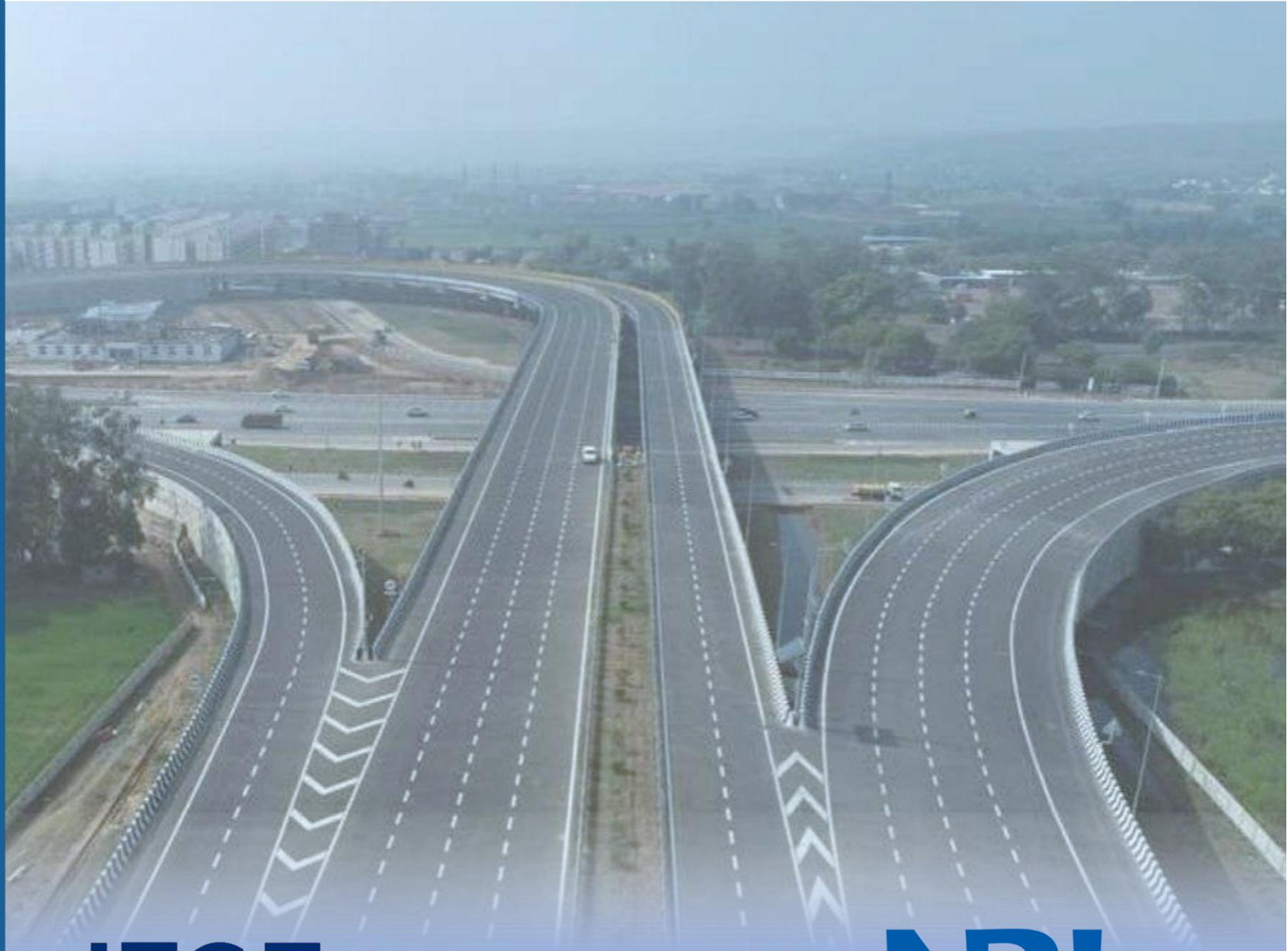

IFGE
Indian Federation of Green Energy

NRI

Model Draft State Green Transport Policy

August 2026

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Background & Context

Harmonizing Growth and Energy Self-Reliance

India being a developing economy faces twin challenges; It needs to sustain economic growth and at the same time reduce dependency on energy imports. Balancing development priorities with energy independence will demand structural reforms and sector-wide interventions.

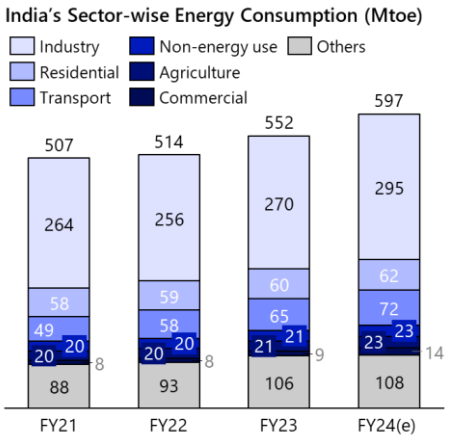


Figure 1: India's energy consumption is growing YoY

Tariffs and geopolitical tensions are disrupting energy supply chains, lowering demand and investor confidence, and creating price volatility. Rising trade barriers, labour constraints, and potential oversupply further strain margins, while signals of long-term decoupling add uncertainty to energy sector especially for multiple growing economies in global south. In low- and middle-income countries of the Global South, biofuels produced from crops supported by the tropical climate, along with select waste and residues such as used cooking oil and tallow, provide an immediate, cost-effective pathway to energy independence while decarbonizing the transportation sector[1].

1.1. India's Energy Dependence and Need for Diversification

India's growth, self-reliance, and sustainability goals are converging on a single structural reality: energy demand is set to quadruple by 2047 as the economy advances toward developed-nation status, even as the country imports 88.5% of the crude oil it consumes today. Petroleum continues to dominate the import basket, exposing the economy to global price volatility and external supply risks, while fossil fuels still account for roughly 75% of India's energy mix, framing the scale of the road ahead to Net Zero. India's mobility system remains structurally dependent on these imported fossil fuels, creating economic and strategic vulnerabilities that extend well beyond the energy sector alone, touching manufacturing, targeted to contribute 25% of GDP by 2030, and the automotive sector, which already generates USD 240 billion in turnover and supports 3 crore jobs. India aims to achieve energy independence by 2047 and Net Zero by 2070, with biofuels as a key driver. Through the Global Biofuels Alliance (GBA) and accelerated adoption of biofuels like ethanol, India is

pursuing a just, inclusive, and equitable energy transition for its 1.4 billion citizens and wider Global South.

Transport sits at the centre of this challenge and this opportunity. The sector contributes 13% of India's total emissions, with commercial vehicles alone accounting for 5%, the largest single share within transport, against overall emissions of 2,839 Mt CO2 equivalent. Emissions from road transport are increasing year on year, accounting for 20-30% of PM 2.5 and PM 10 concentration in India in 2023, and, as per the Economic Survey 2024-25, the transport sector already contributes 78% of the total GVA of transport services, underlining mobility's role as both a driver and enabler of economic growth. As incomes rise and urbanization accelerates, this demand will only intensify: India aims to raise passenger mobility per capita from roughly 4,000 km in 2020 to approximately 14,000 km by 2047, matching benchmarks seen in developed economies today. Without structural changes, this growth will translate directly into higher fuel consumption, emissions, and logistics costs, reinforcing the case for a diversified, resilient mobility energy mix.

India's response is already visible on the ground, with multiple clean mobility pathways advancing in parallel. Electric mobility has reached 8.5% penetration in FY2026, up from 1.7 lakh units in FY2020 to 24.5 lakh units, and this growth is set to become even cleaner as India's grid decarbonizes in parallel, with the government steadily scaling up non-fossil capacity and raising its ambition on this front. Ethanol blending has already reached 20% in petrol during ESY 2025-26, five years ahead of the original target, positioning it as the pathway operating at the greatest national scale today. Compressed biogas is building on this momentum, with CNG's share of India's passenger vehicle sales rising to approximately 20% in 2025 from just 6% in 2020, a direct driver for future CBG growth, while green hydrogen pilots have expanded to vehicles deployed across 21 routes, backed by 16 refuelling stations under the National Green Hydrogen Mission. At the policy level, the Centre is driving this multi-fuel pathway through coordinated blending mandates and dedicated outlays, with ethanol's blending achievement enabling the most immediate decarbonization gains available to India today.

1.2. Climate Change Imperatives and Transport Decarbonization

The transport sector is a major contributor to India's emissions and fossil fuel consumption. Emissions from road transport are increasing year on year, accounting for 20-30% of PM 2.5 and PM 10 concentration in India in 2023[2] .

India's climate commitments further reinforce the need for transition. The country aims to:

- achieve 60% installed power capacity from non-fossil sources by 2035, and
- reduce emissions intensity of GDP by 47% (vs. 2005 levels) by 2035, while targeting Net Zero by 2070.

While electrification will be central, it alone, cannot fully address near-term mobility needs. Moreover, large-scale EV adoption also shifts India's dependence from imported fossil fuels to critical minerals and processing supply chains, where domestic capabilities are still developing.

Although the government has taken several steps to strengthen mineral security and domestic processing, these constraints reinforce the case for a multi-pathway approach to transport decarbonization[3]. Role of Mobility in Economic Growth, Energy Use & Emissions

Mobility is both a driver and enabler of economic growth. As per the economic survey 2024-25, transport sector contributed 78% of the total GVA of transport services during FY 23[4].

As incomes rise and urbanization accelerates, mobility demand is expected to grow significantly. Despite lower per capita mobility, India's aggregate demand is already substantial and will continue to expand.

Without structural changes, this growth will translate into higher fuel consumption, emissions, and logistics costs.

Policy landscape for India's sustainable mobility pathways

India's sustainable mobility transition is being shaped through pathway-specific policy architectures rather than a single overarching transport law. This makes it important to assess policy across two layers: the national layer, where missions, fiscal support, and regulatory frameworks define direction, and the state layer, where these priorities are translated into implementation, investment facilitation, and local market development.

Framework for assessing the policy landscape

This section evaluates all pathways through a common framework. At the central level, it assesses policy objectives, demand-creation mechanisms, supply-side support, and enabling regulations. At the state level, it evaluates the extent to which states have moved beyond alignment into active policy reinforcement through incentives, land support, industrial promotion, and implementation frameworks.

2.1. National Policies and Missions

Electric mobility

Electric mobility has the most layered national policy architecture. FAME-II, with an outlay of ₹10,000 crore, allocated ~86% toward demand incentives and targeted deployment across buses, two-, three-, and four-wheelers [5]. In 2024, PM E-DRIVE (₹10,900 crore) expanded support to additional segments including e-trucks, ambulances, and charging infrastructure[6]. The PM e-Bus Sewa–Payment Security Mechanism further strengthened public transport deployment with ₹3,435.33 crore to support over 38,000 e-buses[7].

Fiscal measures complemented these schemes, including GST reduction on EVs and chargers to 5%, exemption from permit requirements, and advisory to states for road-tax waivers. Together, these measures create a comprehensive adoption and procurement framework[8].

The national EV policy also extends into manufacturing and regulation. The PLI scheme for automobiles and auto components (₹25,938 crore) supports domestic production of advanced automotive technologies, including EVs and their components[9]. The PLI-ACC scheme (₹18,100 crore) promotes battery manufacturing with a 50 GWh capacity target. In parallel, the Ministry of Power issued EV charging guidelines in 2024 and battery-swapping guidelines in 2025, enabling standardization, private participation, and improved

infrastructure access. These measures collectively build the industrial and operational ecosystem required for scale[10].

Biofuels

Within biofuels, the National Policy on Biofuels, 2018, as amended in 2022, remains the umbrella policy guiding adoption of biofuels in the country. The most mature pathway within this umbrella is ethanol. The amendment advanced the target of 20% ethanol blending in petrol from 2030 to ESY 2025-26, and the Ethanol Blended Petrol (EBP) Programme provides the core demand mechanism through OMC procurement and blending[11]. By 31 July 2025, average blending in ESY 2024-25 had reached 20%, 5 years before the intended target of 2030[12].

On the supply side, the Centre has expanded feedstock eligibility, maintained administered pricing, reduced GST to 5%, and introduced interest subvention schemes for distillation capacity[13]. The modified JI-VAN Yojana (2024) expanded support to advanced biofuels beyond 2G ethanol.

Biodiesel policy support exists but is more limited in scope. The 5% blending target remains indicative, and the pathway is primarily supported through RUCO (Re Used Cooking Oil), which facilitates collection and conversion of used cooking oil. As a result, biodiesel operates within a circular-economy framework rather than a large-scale transport fuel programme[14].

For compressed biogas (CBG), the national framework has evolved meaningfully over the last few years. The anchor remains SATAT, launched on 1 October 2018, which aimed to establish an ecosystem for production of CBG from waste and biomass and to secure offtake through oil and gas marketing companies. This architecture was strengthened materially when the National Biofuels Coordination Committee approved the CBG Blending Obligation in late 2023. Under this framework, blending remains voluntary until FY 2024-25 and becomes mandatory thereafter at 1% in FY 2025-26, 3% in FY 2026-27, 4% in FY 2027-28, and 5% from FY 2028-29 onward. In parallel, MNRE's National Bioenergy Programme, notified for FY 2021-22 to FY 2025-26, provides a wider support base for biogas, Bio-CNG, and waste-to-energy projects.[15] In addition to these efforts, the Union Cabinet approved GOBARdhan, the National Circular Bioenergy Scheme, in August 2026, consolidating what were previously several separate central schemes into a single, unified framework with an outlay of ₹23,731 crore, to be implemented from FY 2026-27 through FY 2035-36. GOBARdhan is designed to nearly ten-fold India's domestic CBG production, anchored by an assured CBG offtake mechanism through city gas distribution entities and a stable, government-backed administered price of

₹2,110 per MMBTU, giving producers the long-term revenue visibility needed to support capacity utilization and attract sustained private investment.

SAF remains at an early stage but is now part of the national policy direction. Initial demonstration flights and blending targets (1% by 2027, 2% by 2028, 5% by 2030) signal intent, while supply-side frameworks continue to evolve through refinery readiness and advanced biofuel support[16].

Green hydrogen

Green hydrogen policy is mission-driven and ecosystem-focused. The Ministry of Power's Green Hydrogen Policy enabled renewable energy access, open access provisions, and transmission waivers. The National Green Hydrogen Mission (₹19,744 crore) provides the core framework, including the SIGHT programme, mobility pilots, infrastructure development, and R&D.[17] By March 2025, five pilot projects involving 37 hydrogen vehicles and 9 refuelling stations had been sanctioned. While the policy architecture is comprehensive, mobility deployment remains at a pilot stage, reflecting the early maturity of the pathway[18].

2.2. State Policies and Their Assessment

India's state-level clean mobility policy landscape is evolving but remains fragmented across fuels and departments. EV adoption has seen the strongest policy push, while biofuels and hydrogen are emerging more selectively. In the past, various states and union territories have developed EV policies which supported hybrid and electric vehicles[19], 13 states have green hydrogen policies[20] and approximately 10 states have dedicated biofuel policies with different maturity levels. The policies for the most mature states are listed below.

Uttar Pradesh: UP's EV Policy 2022 provided 100% road tax waivers and purchase subsidies to hybrid and electric vehicles. This policy in addition to driving a strong e-rickshaw market (e-rickshaws constitute 81% of total EV sales in the state) also promoted the uptake of hybrid and EV 4 wheelers in the state. On hydrogen, UP's 2024 Green Hydrogen Policy offers a capital subsidy of up to 40% for the first five projects, with a cap of ₹225 crore per project per year. UP offers capital subsidies ranging from 25 to 35% for green hydrogen, among the highest in the country. Also, UP's Bioenergy Policy 2022 offers capital subsidies of up to ₹20 crore per project, alongside a 100% state GST reimbursement for ten years, to accelerate CBG, bio-coal, and bio-ethanol production statewide.

Maharashtra: Maharashtra's EV Policy 2025 offers purchase subsidies up to ₹2 lakh for commercial four-wheelers and complete waivers of road tax, registration fees, and a 100%

toll waiver for passenger EVs on major expressways[21]. On hydrogen, the state subsidizes the first 500 hydrogen fuel-cell vehicles for MSRTC and caps Hydrogen Refuelling Station development at ₹4.5 crore, with a ₹50/kg grant for blending green hydrogen with CNG. Maharashtra also offers a ten-year waiver on intra-state transmission charges for green hydrogen producers[22].

Karnataka: Karnataka's Clean Mobility Policy 2025–30 targets ₹50 thousand crores in investment to establish the state as Asia's premier clean mobility hub, offering 100% road tax exemptions and capital subsidies for EV manufacturing. The state leads India in EV charging infrastructure with 5,880 public stations, mandating chargers every 3 km in Bengaluru. The Karnataka State Bioenergy Development Board is also in talks to introduce a new biofuel policy in state.

Delhi: Delhi's EV sales have grown 4.5 times over the last six years, from 23,683 units in FY2020 to over 1,07,465 units in FY2026, with EV penetration reaching 12.6% of new vehicle sales in FY2026, among the highest of any Indian state. Delhi EV Policy 2.0 draft released in April 2026, proposes full tax waivers to cars under ₹ 30 lakh[23]. On hydrogen, operational trials of green hydrogen-fuelled buses were launched in the Delhi-NCR area. Biofuels follow national E20 policy guidelines.

Assam: Assam's EV Policy 2021 targets 25% EV share in new registrations by 2026, with ₹10,000/kWh subsidies for two-wheelers and all government vehicles electric by 2030[24]. The Integrated Clean Energy Policy 2025 targets ethanol production of 1,500 KL/day and bio-CNG at 10,000 TPD, with 25% capital subsidies for CBG plants[25]. On hydrogen, the state targets 2,000 KTPA of green hydrogen by 2030, backed by 30% electrolyzer subsidies and a 20-year transmission charge waiver[26].

2.2.1. Electric mobility: Delhi, Uttar Pradesh & Maharashtra

Electric mobility has the widest state-level policy adoption. Delhi’s EV Policy set a target of 25% EV share in new registrations, supported by charging plans and implementation frameworks. Uttar Pradesh and Maharashtra have combined consumer incentives with manufacturing, infrastructure, and recycling provisions[27].

Overall, EV policy has evolved into a coordinated federal ecosystem, with multiple states building complementary frameworks around central policy signals.

2.2.2. Biofuels: Uttar Pradesh & Assam

State-level support for biofuels is more selective and varies by pathway. Uttar Pradesh's Bio-Energy Policy 2022 provides capital subsidies, SGST reimbursement, and stamp-duty exemptions, positioning the state as a facilitator of waste-based energy ecosystems. This highlights how state policy quality directly affects scale-up[28].

SAF is still emerging at the state level, with early industrial positioning seen in Uttar Pradesh's proposed SAF policy. This reflects a first-mover approach rather than widespread adoption.

Ethanol policies, such as Assam's Ethanol Production Promotion Policy (2022), focus on production and investment facilitation rather than demand-side mandates. This indicates a division of roles, where the Centre drives market creation and states support supply ecosystems.

Biodiesel remains limited at the state level and is typically embedded within broader bioenergy policies. CBG shows stronger state dependence due to its reliance on local feedstock and logistics.

2.2.3. Green hydrogen: Gujarat, Andhra Pradesh & UP

State policy activity is also visible in green hydrogen, though in a relatively concentrated group of industrially ambitious states. Gujarat's Green Hydrogen Policy targets 3 MMTPA by 2035. Andhra Pradesh's Green Hydrogen and Green Ammonia Policy 2023, targets 0.5 MMTPA of green hydrogen or 2.0 MMTPA of green ammonia within five years. Uttar Pradesh's Green Hydrogen Policy 2024 targets 1 MMTPA by 2028 and includes incentives such as 100% stamp duty exemption, concessional land provisions, and capital subsidy. These policies are primarily focused on production ecosystems and industrial investment, with limited immediate impact on mobility deployment.

2.3. *Comparative assessment of state-level policy support*

The charts below assess state-level maturity of EVs and biofuels.

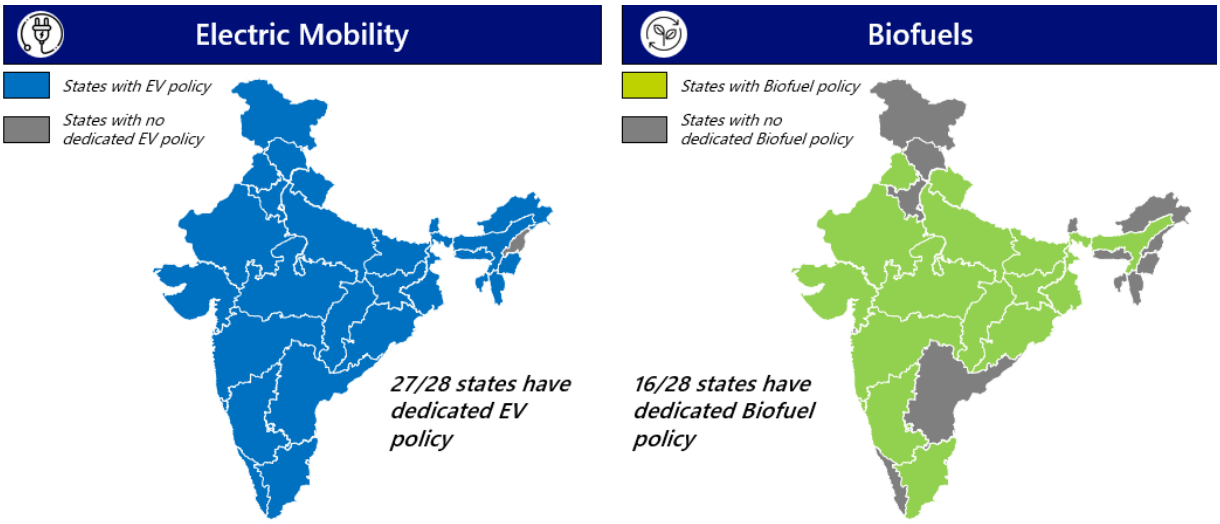


Figure 2: Comparative Assessment of States with policies for EVs and Biofuels

The state-policy landscape remains uneven across the two pathways. With no fuel pathway completely mature, EVs show the strongest policy push, driven by clear targets, fiscal incentives, and rapid charging infrastructure scale-up. Biofuels are moderately mature, supported by ethanol blending mandates and supply-side investments. However, to drive offtake of biofuels, demand-side incentives are needed on the consumer side, particularly within the automotive sector, which accounts for more than 75% of biofuels consumption, by providing fiscal support to vehicle segments such as FFVs and electrified FFVs.

India's sustainable mobility landscape

India's sustainable mobility transition cannot be understood through a single technology lens. The scale, diversity, and uneven economics of India's transport system prove that one pathway alone will decarbonize mobility in the near to medium term. Road transport accounted for ~12% of India's energy-related CO_2 emissions in 2025 and under current trajectories with growing fleets and urbanization, emissions could double by 2050[29]. At the same time, India's transport mix remains heavily road-centric: roads account for roughly 78% of passenger traffic and 66% of freight movement[30]. This makes mobility decarbonization not only an environmental challenge, but also a strategic one from the standpoint of energy security, trade balance, and industrial policy.

In this context, India's sustainable mobility landscape is best viewed through three parallel pathways. Electric mobility offers zero-tailpipe-emission pathway and will also contribute

towards lowering carbon emissions as electricity generation in India will become cleaner. Biofuels offer lower-carbon liquid and gaseous substitutes that can work within existing vehicle and fuel ecosystems, making them important transition pathway for vehicles segments, where electrification may not scale at speed. Green hydrogen remains an emerging pathway but offers longer-term promise for harder-to-abate segments such as heavy-duty mobility and selected industrial applications, with Hydrogen-ICE also emerging as a complementary, lower-cost route for these same segments. Together, these pathways the next frontiers to be encouraged**.**

3.1. Electric mobility

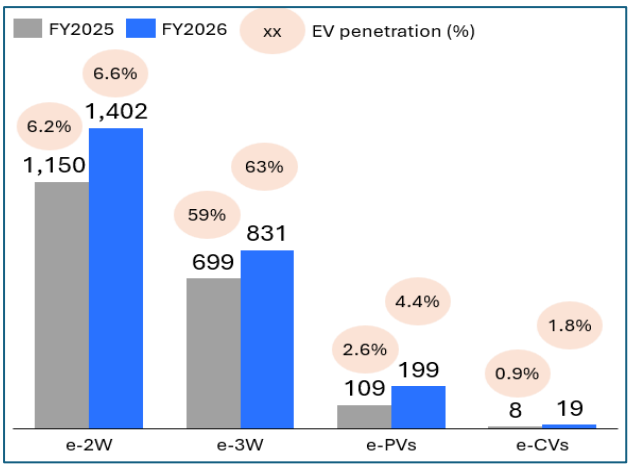
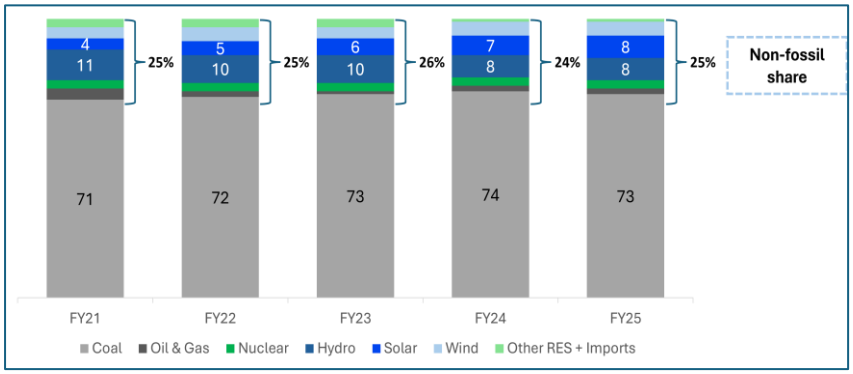


Figure 3: Electric Vehicle sales (Thousands) and penetration (%) across segments in India (Autocar)

Battery electric vehicles eliminate tailpipe emissions and are significantly more energy efficient than pure internal-combustion engines, making them a natural fit for segments with predictable duty cycles and manageable charging needs. India has recorded measurable progress here: EV sales have grown from 1.7 lakh in FY2020 to 24.5 lakh in FY2026 (~8.5% EV penetration), a CAGR of 55%, driven primarily by e-2W sales (6.6% penetration) and rapid electrification of the 3W fleet (63% penetration).[31] [32]This growth is segment-specific -adoption is strongest in 2W and 3W, while passenger and commercial

vehicles are still building up (4.4% and 1.8% penetration respectively), reflecting an EV story led by lighter, last-mile vehicles.



Realizing the full benefit of this pathway, however, depends on several parts of the ecosystem maturing alongside vehicle adoption.

Figure 4: Generation % by Energy Source in India (2021-2025, CEA)

EVs' carbon benefit is tied to the power grid, coal still accounted for around 69% of total electricity generation in 2025-26 (up to 31 January 2026), so decarbonization of the grid and electrification need to progress.

The battery value chain is a second dependency: India's capabilities in minerals, processing, and manufacturing are still developing, and reliance on imported lithium, cobalt, nickel, and rare earths exposes the sector to global supply and price movements. Further, as China controls most of the downstream mineral processing capability, India's EV supply chain remains exposed to global sourcing and pricing decisions well outside its own borders[33]. Charging infrastructure is a third -public charging has expanded to 29,277 stations as of August 2025 (up from ~25,000 in October 2024), but density and geographic spread still need to scale meaningfully to support four-wheeler, bus, and freight electrification.[34]

Taken together, EVs will anchor long-term decarbonization in 2W, 3W, and urban fleets, but the pace of that anchor and its reach into heavier, harder-to-electrify segments depends on the grid, the battery value chain, and charging infrastructure maturing in parallel. This is why

India's mobility transition cannot be planned around electrification alone, and why the pathways that follow -biofuels and green hydrogen -are equally central to this landscape.

3.2. Biofuels

Biofuels work within vehicles and fuel infrastructure that already exist. This is what positions them as an immediate, mass-scale decarbonization lever for India's transport sector the benefit accrues to the fleet already on the road, rather than depending on a new vehicle technology cycle to take hold. India's biofuel portfolio spans ethanol, biodiesel, compressed biogas (CBG), and sustainable aviation fuel (SAF), each at a different stage of development and suited to a different part of the transport system.

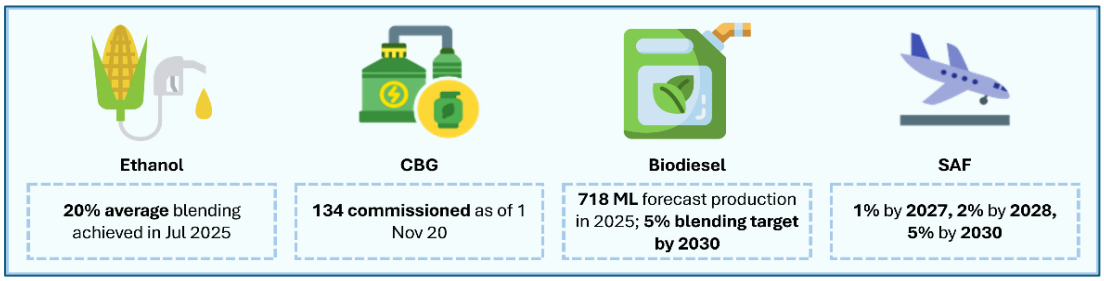


Figure 5: Biofuels in India-Progress and Targets (PIB)

Ethanol

Within this portfolio, ethanol has reached a stage of development that allows it to contribute at the scale of India's operating vehicle fleet. The installed distillery capacity stands at 2,000 crore litres.[35] Nationwide E20 blending was achieved in July 2025, five years ahead of the original target, and all new vehicles have been E20-engine-tuned since April 2025. This combines a fleet already compatible with the fuel, and a supply base already built to support it is what allows ethanol to deliver near-term impact at scale, alongside the continued development of biodiesel, CBG, and SAF.

Ethanol has multiple benefits some of which are as follows:

1. **Farmer Income and Forex Savings:** Under the Ethanol Blended Petrol (EBP) Programme, blending has saved over ₹1.97 lakh crore in foreign exchange and displaced nearly 316 lakh tonnes of crude oil since ESY 2014-15, strengthening India's energy security by reducing reliance on imported crude Over the same period, the programme has generated more than ₹1.66 lakh crore in additional farmer income, providing sustained support to the agrarian economy through assured demand for sugarcane and grain surplus.[3637]

2. **Carbon Neutrality:** Ethanol's (Biofuels) emissions are biogenic, meaning the carbon released during combustion is carbon that was originally absorbed from the atmosphere by the crop itself during its growth, rather than carbon extracted from long-buried fossil reserves. This closes the loop in a way fossil fuels cannot, and in the Indian context, biofuels consequently have the lowest lifecycle carbon intensity among all fuel and powertrain types. Recognition of this biogenic advantage is also taking shape in global policy, with international markets now moving to account for it directly in how vehicles are taxed and regulated. Brazil, for instance, links vehicle taxation to well-to-wheel CO_2, a measure combining fuel carbon intensity with vehicle efficiency rather than treating all tailpipe emissions the same way regardless of fuel source. As India's own fuel-efficiency framework evolves, a similar approach offers a reference point for how ethanol's biogenic emissions profile could eventually be reflected more precisely in vehicle-level carbon accounting.[38]
3. **Energy Security:** Unlike crude oil, ethanol's value chain, from feedstock cultivation and distillation to blending, is largely domestic, strengthening India's energy security and reducing exposure to external supply disruptions. During periods of global crude oil volatility, such as the recent tensions in West Asia, domestic ethanol blending has helped moderate the impact of international price fluctuations on India's fuel supply. At the same time, the Government has consistently positioned the ethanol blending programme as an energy security and import substitution initiative rather than a measure to ensure lower fuel costs under all market conditions. Accordingly, the programme's benefits are better viewed in terms of reduced import dependence, foreign exchange savings, and greater resilience of the fuel supply chain, rather than as a mechanism for delivering lower fuel prices across all phases of the crude price cycle.

Sustainability of Ethanol Production

Feedstock and Food Security

Ethanol production in India is built around surplus grain and sugarcane availability, sourced only after domestic food requirements are met. Over time, the feedstock base has diversified meaningfully: grain-based ethanol rose from under 5% of total output in 2019 to nearly 67% of supply by June 2026, with maize now the largest single feedstock, reducing dependence on sugarcane alone. This shift is set to be reinforced by improving maize yields: India's average productivity today stands at roughly 3.5-3.7 tonnes per hectare[39] with considerable headroom for improvement through high-yielding hybrid varieties and better starch content, an area where

ICAR's Indian Institute of Maize Research is already developing hybrids capable of 10-11 tonnes per hectare under optimal conditions[40]. Continued investment in second-generation (2G) ethanol, produced from crop residues and other non-food biomass, represents the next stage in this diversification, broadening the feedstock base further over time, with India's roughly 350 million tonnes of annual agricultural residues[41] offering the potential to yield higher litres of ethanol per tonne as enzymatic hydrolysis and pretreatment technologies continue to mature.[42]

Water Use in Ethanol Production

Ethanol production draws on feedstock that already exists as surplus grain and sugarcane grown to meet regular agricultural and food demand, with the portion beyond that requirement channelled into ethanol rather than cultivated separately for this purpose. Since this feedstock's water use occurs as part of standard crop cultivation regardless of its eventual use, ethanol production itself does not create an additional, dedicated water requirement at the cultivation stage. Water use within the distillery process itself remains a separate and comparatively modest component of the overall picture. Further it is compulsory for the distilleries to ensure Zero Liquid Discharge.

CBG

CBG is emerging as a key fuel linking mobility with waste management and rural income, and India's build-out has crossed a meaningful threshold. As of early January 2026, India had 132 operational CBG plants with a combined production capacity of 920 tonnes per day, up from 100 plants and about 700 tonnes/day of capacity as recently as March 2025.[43]

CBG's distinguishing strength is that it has two monetization pathways, the fuel as well as organic manure generated as a byproduct. Feedstock, agricultural residue, cattle dung, and municipal solid waste, is converted into fuel, while the fermentation process yields organic manure as a saleable co-product, adding a rural income stream on top of the core CBG sale. Few competing fuels combine waste management and farm-linked income generation this directly.

The demand-side gap that held CBG back for years is now closing. The National Biofuels Coordination Committee approved a phase-wise mandatory CBG blending obligation in the CNG (Transport) and PNG (Domestic) segments of City Gas Distribution networks on 24 November 2023: voluntary until FY2024-25, then mandatory from FY2025-26 at 1%, rising to

3% in FY2026-27 and 4% in FY2027-28. This converts CBG from a subsidy-led product into one with a legislated offtake floor.

This mandate matters most for gas-based transport specifically, since CBG blends directly into existing CNG infrastructure and vehicle fleets under government co-mingling guidelines, that makes it the most immediate decarbonisation lever within the gas segment. Its economics also favour states with strong agricultural residue and municipal waste bases, naturally aligning plant siting with the region's best placed to capture the rural income benefit.

Beyond ethanol, CBG shows that India's biofuel pathway extends across multiple fuels rather than a single one. Its production is inherently decentralised and rural, tied to local agricultural and waste availability rather than grid or refinery infrastructure, which diversifies the fuel base geographically as well as technologically. With the blending mandate now phasing in, CBG adds a domestic, fuel-agnostic supply source that complements electrification, hydrogen, and liquid biofuels rather than competing with them.

Biodiesel

Biodiesel remains limited, driven primarily by used cooking oil under the Repurpose Used Cooking Oil (RUCO) initiative. Currently, biodiesel blending ratio remains low (~0.5% in 2024) and to achieve the 5% blending target by 2030 India will need to produce ~5 billion Liters which is currently constrained by feedstock availability [44].

SAF

SAF is at an early stage but critical for aviation, with initial flights completed and blending targets of 1% (2027), 2% (2028), and 5% (2030)[45]. This is still an emerging industry, but SAF is important because it represents one of the few credible low-carbon options for aviation over the medium term. Biofuels provide immediate decarbonization benefits by working within the existing vehicle base. However, their scale-up depends on stronger policy support. Ethanol has progressed due to clear market creation, while other pathways lag due to gaps in demand certainty, feedstock logistics, infrastructure, and financing.

3.3. Green hydrogen

Green hydrogen holds long-term potential for hard-to-abate segments such as heavy-duty trucking, long-haul transport, and industrial mobility. Under the National Green Hydrogen Mission, India targets 5 MMT production by 2030, supported by ~125 GW of renewable capacity, an investment of ₹8 lakh crore, and a set of pilot projects.[46] As of 2025, pilots across

10 routes involving 37 vehicles have been initiated, reflecting the early stage of this pathway's deployment.[47]

Green hydrogen's role in mobility is closely tied to production cost and infrastructure build-out spanning production, storage, transport, and dispensing as well as continued progress in low-cost renewable electricity. As these dimensions develop, hydrogen is expected to find its place in the segments where it is best suited: heavy-duty and long-haul applications where EVs and biofuels are less effective, positioning it as a complementary pathway for the hardest-to-abate parts of the transport system.

3.4. What this means for India's mobility transition

India's mobility transition needs to be structurally multi-pathway. Electric mobility anchors the long-term destination, with its full impact tied to the pace at which the grid, battery value chain, and charging infrastructure maturity. Biofuels, led by ethanol, offer the most immediate route to mass-scale decarbonization, working within the vehicle fleet and fuel infrastructure that already exist today. Green hydrogen represents the long-term frontier, positioned for the heavy-duty and hard-to-abate segments where other pathways are less effective.

India is therefore managing three transitions in parallel: each suited to a different part of the transport system and moving at its own pace of maturity.

Rationale for a Multi-Fuel Approach in India

The question for India is not which pathway should dominate, but how multiple pathways can be combined across segments and time horizons. Global examples reinforce this: Indonesia's biodiesel-led model, Brazil's biofuel ecosystem, Europe's regulatory approach, and China's EV-led transition all show that mobility systems evolve through complementary pathways, not a single winner.

4.1. Limitations of a single-fuel strategy

A single-fuel strategy does not fit India's structural constraints. An EV-only pathway faces grid emissions, mineral import dependence, and slower adoption in heavy-duty and aviation segments. EVs deliver lower lifecycle emissions, but this depends on grid decarbonization, development of charging infrastructure and does not address all segments like heavy commercial vehicles.

A hydrogen-only pathway is constrained by cost and infrastructure. Grey hydrogen reduces emissions by only 11-18%, while green hydrogen requires ~120 GW of renewable capacity and costs ₹325-400/kg by 2030, rising to ~₹650/kg with distribution not a near-term, system-wide solution.[48]

A biofuels-only pathway also has limits at current blend levels, but unlike the other two, these limits are policy-driven rather than structural: higher blends, technology shifts, and integrated frameworks can unlock much greater impact quickly, as Brazil has shown. Further higher ethanol blends will also require a concerted development of 2G ethanol production capacity, so that the dependence on food crops remains controlled.

No single pathway optimizes speed, energy security, industrial depth, and affordability together. NITI Aayog's 2026 scenarios support a phased, diversified approach and among the three, biofuels are the pathway India is best positioned to scale fastest[49]. NITI Aayog recommends that the transition strategy should begin with the phased elimination of polluting vehicles and the adoption of lower-emission technologies such as CNG, Hybrids, and Electric Vehicles. The subsequent phase should advance with the use of biofuels through FFVs, high Bio-CNG blends, and Hybrid FFV models, alongside continued growth in EV adoption. The final phase should ensure full deployment of Zero-Emission Vehicles (ZEVs) such as EVs, hydrogen-based vehicles, FFVs, and CBG-based models.

4.2. Import and carbon intensity across pathways

The strongest case for diversification is that each pathway solves a different form of dependence. Conventional oil-based mobility remains the most import-exposed part of the system: crude-oil import dependence was 88% in FY 2024-25 and 89% in FY 2025-26 up to January 2026, with natural-gas dependence at about 50-51%.[50] Diversification has pushed the share of crude routed outside the Strait of Hormuz to about 70%, up from 55%- progress, but the system remains tethered to volatile global markets.[51]

EVs reduce oil dependence but shift reliance to imported minerals and processing, with China dominating ~90% of rare earths and graphite, ~80% of cobalt, and ~70% of lithium processing.[52]However, focused steps are being taken to develop domestic supply chains, but these will take some time to develop, hence in the meanwhile, other readily available pathways can support mobility decarbonization.

Biofuels the one pathway built on domestic feedstock. NITI Aayog projects a 40-million-tonne surplus, 16 billion Liters of ethanol, and 87 BCM of biogas potential.[53] Even at today's levels the gains are real, and FFVs, CBG, can push emissions benefit much further.

Green hydrogen offers low carbon but high resource intensity and is not a mass-market solution; for India it is best kept as a selective, high-value fuel for segments where EVs and biofuels fall short.

4.3. Strategic and economic benefits of diversification

A multi-fuel strategy enables layered decarbonization - biofuels in existing ICE fleets, EVs in urban and light-duty segments, hydrogen in heavy vehicle segments with specific use cases in high-utilization applications - accelerating the overall pace of transition.

It also expands domestic value creation. EVs support advanced manufacturing, hydrogen enables industrial and renewable integration, but biofuels carry the broadest economic reach: rural income, waste-based ecosystems, and agricultural linkages that the other two pathways cannot replicate at the same scale.

4.4. Geopolitical rationale

India faces dual external dependence on fossil fuels and on critical minerals. Oil imports expose the economy to price volatility; clean-energy supply chains are concentrated globally. A multi-fuel strategy hedges both risks, but biofuels do the most direct work: they cut oil dependence today, using domestic resources, without creating a new import dependency in their place.

4.5. Summary assessment

A multi-fuel approach is essential for India: EVs for urban decarbonization, hydrogen for hard-to-abate segments but given India's import exposure, resource base, and pace of deployment needed, biofuels will also form a key component of that approach.

Centre-State Alignment: From National Framework to State-Level Impact

A national multi-fuel framework establishes the overall direction for India's mobility transition, but direction alone does not guarantee delivery. India's mobility market is not singular or uniform; it is a collection of distinct state-level systems, each shaped by its own vehicle mix, industrial base, feedstock availability, grid capacity, and fiscal headroom. A policy architecture designed centrally and applied uniformly across states will only be effective if it treats this diversity as a core design parameter rather than a secondary consideration.

The mobility landscape varies sharply across states. A state with a large two-wheeler and three-wheeler parc has a fundamentally different decarbonization opportunity than one dominated by heavy commercial vehicles or agricultural machinery. A state with strong sugarcane or paddy-straw availability is positioned differently on biofuels than one without an established feedstock base. A state with an already-stressed distribution grid cannot absorb EV charging load the way one with surplus renewable capacity can. These are not marginal differences - they determine which fuel pathway is even feasible in the near term, let alone optimal.

A differentiated, state-responsive pathway allows each state to move in line with its own landscape, translating strong policy intent into effective adoption. It also enables states that are ready to move faster on a particular pathway to do so, calibrating expectations to local realities rather than a national average. In both respects, the result is the same: faster, more cost-efficient, and more resilient decarbonization that fully captures the underlying potential.

Importance of a State led Multi-Fuel Policy

India's sustainable mobility transition will be delivered through the combined strength of central direction and state-level execution, advanced state by state, city by city, and corridor by corridor. This collaborative approach is especially critical in a multi-fuel transition, where enabling conditions differ sharply across electric mobility, ethanol, biodiesel, CBG, SAF, and green hydrogen. A stronger state-level policy framework is therefore central to the transition: the operational layer through which national targets and national capacity become deployable, on-ground outcomes.

This is already visible in the EV segment, where state policies have translated national intent into targeted measures, fiscal support, charging roll-out, and public-transport procurement. This same model of translation holds strong potential for other fuels, particularly biofuels and hydrogen, where pathways depend heavily on state-controlled factors such as land, infrastructure, waste systems, biomass logistics, industrial approvals, and public fleets, positioning states to play a leading role in driving adoption. Among these, biofuels and ethanol stand out as offering the greatest opportunity, where the strong foundation already built at the national level is well-placed for states to convert into usable, local demand.

6.1 Alignment with central policies and targets

The primary reason states need a dedicated green mobility policy is to align local implementation with national direction. In electric mobility, this alignment is already visible: NITI Aayog reports that, as of 1 June 2025, 29 states and UTs had notified EV policies, and a majority offer 100% registration-fee and road-tax waivers for at least some vehicle categories.[54] This broad spread of state policies has helped convert central demand support into localized adoption momentum showing that where state frameworks exist, they materially accelerate uptake.

Green Hydrogen follows a similar logic at an earlier stage: the Centre's national Green Hydrogen Mission and other policy frameworks provide a strong foundation, with deployment poised to be led by the states that bring together the land, renewable access, and industrial clusters needed to scale it.

Biofuels present the clearest version of this opportunity. The Centre has already built substantial direction and capacity here, blending mandates, mission frameworks, and pilot programmes for higher ethanol blends (E85), CBG, SAF, and hydrogen. Ethanol in particular

now has significant installed production capacity at the national level, creating a strong foundation for states to build upon. Translating these national targets and this national capacity into on-ground results is where state-level frameworks add the most value. A state's actual ethanol offtake, through FFVs, blending infrastructure, and vehicle segments, depends on factors and choices which are state specific, positioning states as key partners in unlocking this potential.

6.2 Importance of localized policy design

Green mobility reflects India's significant spatial and economic diversity. States differ in vehicle mix, industrial structure, agricultural base, urban density, logistics corridors, refinery presence, gas-grid access, renewable resource availability, and fiscal capacity.

This diversity creates a strong case for localized policy design. Gujarat's freight-heavy, port-led profile illustrates the opportunity well: because port-based freight follows fixed routes and centralized hubs, it is well suited to fuels such as hydrogen or CBG, where refuelling infrastructure can be concentrated for maximum impact. Passenger-focused states such as Delhi present a different profile, while lower-income regions, well suited to two- and three-wheelers, offer strong potential for more distributed, cost-sensitive approaches.

This localization offers the greatest opportunity for biofuels, and ethanol specifically. Ethanol demand and viability are closely tied to the state's own vehicle parc, particularly the presence of FFVs and cars/LMVs, as well as its distillery capacity, sugarcane or grain feedstock base, and existing blending infrastructure. Two states with identical national blending mandates can therefore see very different real-world ethanol utilization, reflecting the value of tailoring policy to each state's unique vehicle mix and feedstock base. CBG follows a related but distinct logic: it depends on residues, waste aggregation, livestock density, and gas connectivity, positioning states to lead the development of biomass supply systems under SATAT. SAF and hydrogen offer even greater scope for location-specific policy leadership, with Uttar Pradesh having initiated SAF policy efforts and a select group of states beginning to pioneer hydrogen policy. Across all these pathways, though, ethanol is the one where the state already has the most capacity to work with, making localized ethanol policy the most immediately actionable piece of the biofuels agenda.

6.3Role of states in driving last-mile adoption

States control many of the levers that determine real-world adoption. Public transport is the clearest example: under FAME-II and PM E-DRIVE, central support for electric buses is routed through state transport undertakings and urban agencies, and even where funding is central, states determine deployment, routes, contracts, depots, and operations.

For biofuels, adoption depends heavily on state-level facilitation like storage, distribution, waste systems, mandi linkages, and local ecosystems. For ethanol specifically, this means state support for FFV uptake, retail blending infrastructure, and coordination with existing distillery capacity: areas where states are best positioned to convert national capacity into ground-level results. Hydrogen follows a similar pattern, depending on industrial clusters, freight corridors, refuelling approvals, renewable access, and safety clearances, all functions that sit within state jurisdiction, making close Centre-state coordination essential to scale beyond pilot programmes.

States are therefore the bridge between national ambition and execution. The Centre sets direction and builds capacity; states are well positioned to decide how best to deploy that capacity for ethanol. Given the scale already built up nationally, this represents a timely and compelling opportunity to act. Ethanol offers the widest, most immediate multi-fuel decarbonization potential available to states in the near term, making it the natural starting point for state-level policy attention.

Guiding Framework for State-Led Ethanol Based Bio mobility Promotion

7.1 Why this framework is needed

E20 is the base blending target set at the central level, applying uniformly across the country. However, India's installed ethanol capacity stands at ~2,000 crore litres, while actual quantity supplied to Oil Marketing Companies (OMCs) was only ~1,100 crore litres.[55]

The need of the hour is to create long-term demand for Ethanol offtake beyond E20. There is significant potential to utilise higher levels of Ethanol through the adoption of Flex Fuel Vehicles (FFVs), including Electrified-FFVs (which have dual powertrain comprising of Ethanol ICE and Electric Drivetrain). Flex Fuel Vehicles are internal combustion engine vehicles designed to operate on varying ethanol blends, ranging from 20% to 100%. However, like for all green technologies such as electric vehicles, consumer acceptance of FFV and Electrified-FFVs will be equally important. Being costlier than conventional technology, it would be necessary to create demand through fiscal incentives and encouraging use of higher Ethanol blend (E85).

Utilization of existing capacity will also play a key role in expanding the support to the rural economy and improving incomes, apart from helping support decarbonization objectives. However, the challenge of overcapacity is not uniform across states and hence each state needs to develop an action plan based on its own requirement and ethanol production potential. Two axes that define a state's position.

7.2 State Categorisation

Every state can be placed against two dimensions:

- **Feedstock potential:** The availability of sugarcane and maize cultivation that can be converted into ethanol. Grain-based potential more broadly is not considered here, since it depends on surplus made available by the government rather than a state's own agricultural base.
- **Production capacity and its utilization**: How much distillery capacity is already installed, and how much of it is being used.

Based on the above two parameters, states can be divided into three categories from the perspective of framing policies for ethanol utilization:

- **Category A Scaling States:** States with large installed ethanol production capacity and available feedstock, where capacity utilization is typically below 35%. These states represent a demand-side opportunity: the infrastructure to produce more ethanol already exists, and the priority is to convert this ready capacity into on-road fuel use. This category includes states such as Uttar Pradesh, Maharashtra, Bihar, Punjab, and Haryana.
- **Category B Building States:** States where ethanol production capacity does exist and feedstock is available, but where capacity remains smaller relative to that potential, leaving room to scale up production further. These states represent a supply-side opportunity: expanding capacity allows the state to capture its underlying feedstock advantage more fully, rather than relying on ethanol sourced from other states. While the primary focus for these states should be on supply-side expansion, demand-side incentives can also be introduced in parallel, giving investors the confidence to commit to upstream capacity. This category includes states such as Tamil Nadu, Rajasthan, Odisha, and Assam.
- **Category C Enabling States**: States with limited feedstock availability, where as a result limited or no installed capacity has been added. These states represent a foundation-building opportunity: the production base itself is still developing, and the priority is to strengthen participation in India's inter-state ethanol supply network as the groundwork for future demand-side policy. This category includes states such as Jharkhand, Arunachal Pradesh, Kerala, and Goa.

This is the logic that produces the three categories below.

Category A: Feedstock available, capacity available but underutilized

States with a well-established feedstock base and substantial installed distillery capacity, where a large share of that capacity is not being utilized. The constraint is offtake, not production.

These states-built distillery capacity ahead of a strong in-state demand signal ethanol production here has historically served national blending requirements routed through OMCs, rather than being consumed locally at higher blends through FFVs.

Illustrative example –

Uttar Pradesh: With an installed capacity of more than 330 crore litres in ESY 2024-25 and a utilisation level of less than 30%, the excess ethanol can be tapped, creating additional income of ₹9,300 crore for farmers and 3.7 lakh additional jobs in agro-rural regions.

Maharashtra: Installed capacity of ~396 crore litres against OMC supply of only ~69 crore litres in ESY 2024-25 a utilization rate of ~17%.[56] Even a modest increase in local FFV-driven ethanol consumption would absorb a meaningful share of this idle capacity without requiring any new distillery.

Priority intervention: Demand-side, centred on FFV adoption

Driving utilization in these states means increasing FFV adoption, which in turn depends on ensuring cost parity with petrol vehicles alongside a running-cost benefit for consumers. Both dimensions need addressing together for FFV demand to build at scale. Currently, tax rates (GST & Road Tax) levied on FFVs and Electrified-FFVs are same as conventional Petrol vehicles. Consequently, consumers bear higher taxes in absolute rupee terms and are inadvertently penalized for purchasing these cleaner technology vehicles over conventional petrol vehicles.

For FFVs, States in this category should prioritize:

- **Exempting or lowering road tax rate** on FFVs & Electrified-FFVs to ensure that consumers should not be paying higher tax amount to purchase these technology vehicles as compared to an equivalent conventional vehicle.
- **Running-cost assurance** to price E85 sufficiently lower than E20 to offset the mileage penalty, so the cost-per-km comparison genuinely favours the buyer. This can be achieved through fiscal rationalization by supporting central-level review of GST applicable on E85 (currently under policy discussion for reduction) since a lower tax rate on the fuel widens the effective price gap without requiring additional state subsidy outlay.
- **Priority E85 dispensing infrastructure**: Active coordination with OMCs for fast paced E85 dispensing infra build-out.

For offtake of surplus ethanol, as an immediate step, the government can introduce an ethanol energy usage incentive that works through FFVs, giving these vehicles a direct route to higher ethanol uptake.

A usage-linked incentive can be designed around an energy-credit model: states plough back the extra tax collected on these green vehicles as energy credits, leverage India's robust public

digital infrastructure such as Vahan, UPI, and Aadhaar to track redemption, and have unused credits returned by the customer if not utilized. This design is intended to be revenue-neutral to government, straightforward to execute, and focused on ensuring the credits translate into energy utilization rather than sitting unused. States can allocate lump-sum credits to buyers of FFVs and FFV-SHEVs, redeemable in part against E85 fuel purchase, with the policy rolled out over 1-2 years to catalyse early demand.

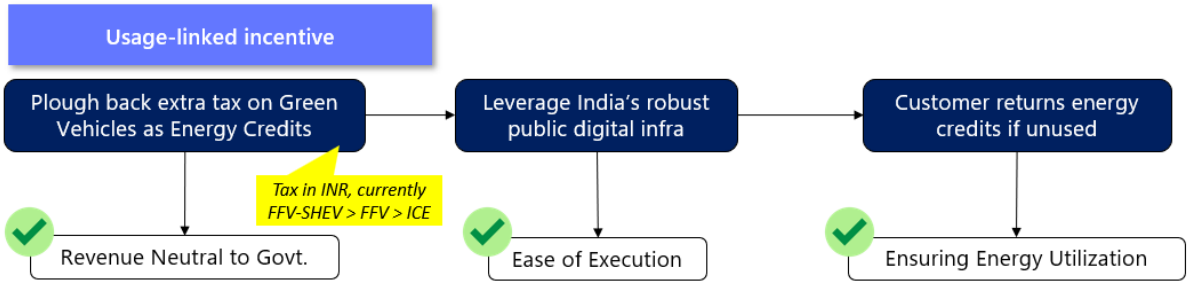


Figure 6: Energy Credits System to drive use of clean energy

Category B: Feedstock available, capacity limited

States with a genuine agricultural surplus that could support ethanol production, but where installed distillery capacity remains small relative to that potential and where existing capacity is already running at moderate-to-high utilization.

Where Category A points to a demand-side opportunity, this category points to a supply-side opportunity: infrastructure here is already operating close to its full potential, a strong signal of established underlying demand for ethanol. Expanding capacity first allows the state to capture this demand within its own borders, strengthening energy security and keeping the economic benefit local, rather than relying on ethanol sourced from other states. The natural sequence for these states is therefore capacity expansion first, followed by demand-side measures, positioning FFV adoption to build on a foundation of strong local supply.

Illustrative example - Gujarat / Chhattisgarh: Gujarat's installed capacity (~40 crore litres) is already running at ~78% utilization; Chhattisgarh's smaller base (~34 crore litres) runs at ~41%. In both cases, there is real feedstock potential (cotton-belt by-products and sugarcane in Gujarat; a large rice surplus in Chhattisgarh) that current capacity does not fully capture the ceiling needs to be raised before demand is pushed against it.[57]

Priority intervention: Supply-side first

- **Capital subsidies and viability-gap funding** for new distillery capacity, sized to the state's actual feedstock surplus.
- **Faster land and environmental approvals** for distillery projects, removing the approval-timeline bottleneck that often constrains capacity build-out more than capital availability.
- **Feedstock aggregation systems**: organized collection and logistics for surplus grain/sugarcane/residue, using the same institutional approach already applied for CBG under SATAT and the model State CBG Policy.
- **Sequenced demand-side rollout**: once a state has meaningfully expanded its production base, it should layer on the same FFV instruments outlined for Category A (purchase incentives, dispensing infrastructure, fleet procurement), but calibrated to its smaller production scale, so demand growth tracks supply growth rather than outrunning it.

Category C: Feedstock limited, capacity limited or absent

States and UTs whose geography (hill states, island territories), land availability (urban UTs), or scale (small UTs) points away from a meaningful agricultural surplus or distillery base represent an integration opportunity: rather than building production capacity, the priority is to strengthen participation in India's inter-state ethanol supply network. This is already a proven, well-established model, formally tracked by OMCs as inter-state ethanol supply to states and UTs without their own production capacity. This category includes states such as Jharkhand, Arunachal Pradesh, Kerala, and Goa.

Illustrative example: Kerala: An established zero-capacity market already receiving meaningful OMC-routed ethanol supply, at approximately 28-31 crore litres annually in recent years, purely through inter-state sourcing.[58] This confirms that the sourcing model already works operationally; what's missing is a demand-side push to use it more fully.

Priority intervention: Enable via sourcing and targeted rollout, not broad-based promotion

- **Continue and formalize inter-state ethanol sourcing:** no in-state production push; the priority is securing supply reliability from producing states rather than building local capacity.
- **Develop production capacity based on 2G or state-specific resources**: where a genuine local opportunity exists, such as bamboo-based ethanol for the North-Eastern states, this

can complement rather than replace inter-state sourcing. Assam, for instance, has the potential to produce 7-8 billion litres of ethanol annually from its bamboo resource.

- **Fleet-first FFV rollout:** government and commercial fleets (such as taxis) as the starting demand base, rather than individual private buyers, before scaling to mass-market adoption.
- **Corridor-based dispensing, not statewide rollout**: E85 availability, alongside broader supporting infrastructure to facilitate cross-state movement, concentrated at a small number of outlets along selected urban centres or highway corridors, rather than spread thin across the state or UT.

The exception within Category C: Delhi

Delhi sits within Category C based on feedstock and capacity alone, but its position is distinct enough from the rest of the category that it warrants separate treatment rather than being read alongside Kerala or any other enabling state. Three factors set it apart:

- its proximity to states with high ethanol production capacity and low utilization, namely Uttar Pradesh, Punjab, and Haryana;
- the severity and persistence of its pollution challenge, which has already pushed the state government to focus on electrification across several vehicle segments;
- and the sheer size of its vehicle market, which contributes a large share of national demand. None of Category C's other states combine all three.

The pollution dimension is where the case sharpens further. Delhi's own 4-wheeler vehicle parc data shows that pre-BS6 vehicles, despite representing 65% of the fleet, are disproportionately responsible for the city's particulate matter load. The scale of that disproportion is clear from the emission standards themselves: certified particulate matter emissions have fallen at every successive standard, from 0.14 g/km under the original BS norm to just 0.0045 g/km under BS-6, an 82% drop from BS-4 alone and a decline of over 96% across the full BS-to-BS-6 progression. This gives Delhi a second, independent lever beyond fuel switching: turning over the pre-BS6 share of the fleet carries an outsized clean-air benefit relative to its share of vehicles on the road.

Given this positioning, and unlike the general Category C approach of prioritizing fleet-first rollout ahead of mass-market adoption, Delhi should focus on driving FFV demand directly in the passenger vehicle segment, where electrification is still growing but has not yet closed the gap. Two actions follow:

- Supporting FFVs through demand-side incentives, to bring them to cost parity with petrol vehicles.

- Expanding the FFV dispensing network in the city to ensure fuel availability keeps pace with vehicle uptake.

The map translates the assessment used throughout this framework - feedstock potential and installed capacity utilization into a single visual reference. Each state's colour reflects where it sits on that assessment, not its overall importance to India's ethanol story; a state in the Building or Enabling category is not "behind," it simply requires a different starting intervention.

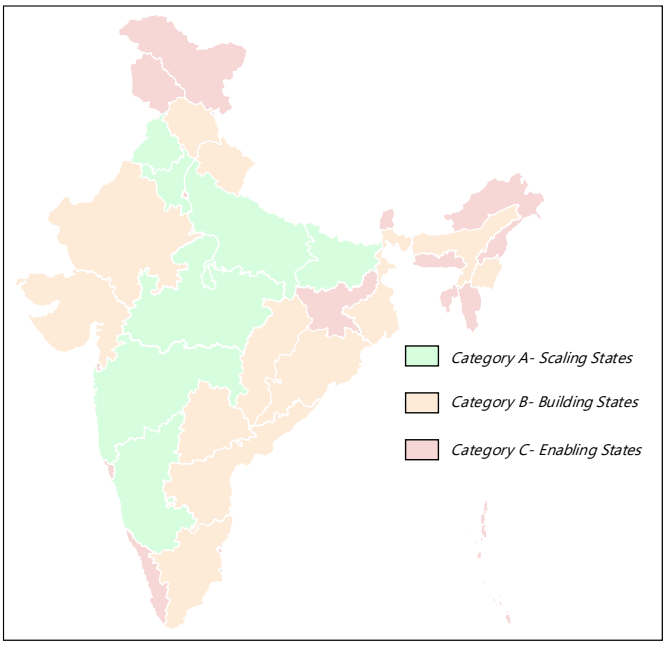


Figure 7: State-wise Categorization for Ethanol Promotion Framework

How the categorization reads on the map:

- **Scaling States (green):** These states form a contiguous belt running through India's established sugarcane and foodgrain heartland: Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Maharashtra, Karnataka, and Bihar. These states-built distillery capacity ahead of local demand, largely to serve national blending requirements, which is exactly why they now hold the largest reserve of ready-to-use ethanol production relative to local consumption.
- **Building States (yellow)** surround this belt on almost all sides - Gujarat and Rajasthan to the west, Odisha, West Bengal, and Assam to the east, Himachal Pradesh and Uttarakhand to the north, Tamil Nadu, Andhra Pradesh, and Telangana to the south. Geographically, These states share the same real agricultural surplus found in the Scaling belt, representing meaningful headroom to build out distillery capacity to match it. Their position on the map highlights strong proximity to feedstock-rich geography, positioning them well to expand their production base in the years ahead.
- **Enabling States (red)** sit at India's geographic edges - Jammu & Kashmir in the north, the northeastern states (Arunachal Pradesh and its neighbours), Kerala in the south, and the island territories. This is a structural pattern, not a policy gap: these are largely hill, island, or small-UT geographies where the agricultural base for ethanol feedstock does not exist at meaningful scale, regardless of intervention. Their placement confirms that inter-state sourcing is the right long-term model here.

Conclusion and Way Forward

India’s sustainable mobility transition is no longer a question of whether change is needed, but of how it should be structured. The analysis in this paper shows that India’s transport future cannot be built on a single fuel or technology pathway. The scale of mobility demand, the continued dependence on imported fossil fuels, the diversity of vehicle segments, and the need to balance decarbonization with energy security all point toward a multi-fuel transition pathway.

Electric mobility, biofuels, and green hydrogen each play a critical role in India's low-emission transport strategy, with the right pathway shaped by segment economics. Biofuels, and ethanol in particular, offer the most immediate, mass-scale route to decarbonization, drawing on infrastructure already in place while reducing the carbon intensity of the existing fleet and supporting segments where electrification will take longer to scale. Electric mobility suits urban, light-duty segments where charging, usage, and economics are favourable. Green hydrogen, still early-stage, holds long-term potential for hard-to-abate applications like heavy-duty freight and industrial corridors. Leading economies advance through combined pathways, not rigid single-fuel models.

The policy implication is clear. India needs to sustain the strong momentum already built in biofuels while continuing to strengthen electric mobility and preparing hydrogen for future deployment. This requires moving beyond a technology-specific approach toward a more outcome-oriented framework based on lifecycle emissions, energy security, scalability, and domestic value creation.

For India, three priorities stand out: the Centre must ensure policy clarity and support innovation and infrastructure; states must drive localized implementation; and public and commercial fleets should act as early anchors to scale diverse fuel pathways effectively across segments.

In essence, India's mobility transition should not be framed as a choice between electrification and alternate fuels. It should be seen as a coordinated transition in which biofuels lead the near and medium term on the strength of what they have already delivered, electrification builds toward the long term, and hydrogen builds future readiness. A balanced and well-sequenced multi-fuel strategy, anchored in ethanol's proven momentum, will be essential to deliver a mobility system that is cleaner, more resilient, and better aligned with India's economic and strategic priorities.

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Footnotes

1 https://www.orfonline.org/research/energy-transition-and-global-south-cooperation-case-of-biofuels

[2] TERI - The Urgent Need for Enhanced Public Transport in India's Air Quality Mission

[3] PIB - India's Critical Mineral Mission - https://www.pib.gov.in/PressNoteDetails.aspx?ModuleId=3&NoteId=155158&reg=48&lang=2

[4] PIB – Sector wise GVA contribution – https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2097889&reg=3&lang=2

[5] PIB - Scheme outlay of FAME India Scheme Phase II - https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2004594&reg=3&lang=2#:~:text=Scheme%20outlay%20of%20FAME%20India,are%20available%2C%20whichever%20is%20earlier.

[6] PIB - PM E-Drive Scheme - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2222604&reg=3&lang=1#:~:text=The%20Scheme%20supports%20more%20than,deployment%20of%2014%2C028%20electric%20buses.

[7] PM India - Cabinet approves PM-eBus Sewa - https://www.pmindia.gov.in/en/news_updates/cabinet-approves-pm-ebus-sewa-payment-security-mechanism-psm-scheme-for-procurement-and-operation-of-e-buses-by-public-transport-authorities/

[8] GST Council - GST rate on all Electric Vehicles reduced - https://gstcouncil.gov.in/sites/default/files/2024-10/36_gst_press_information_bureau.pdf

[9] PIB - Use of electric Vehicles - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2237556&reg=3&lang=1#:~:text=Source%20:%20Vahan%20Portal-,Further%2C%20the%20Ministry%20of%20Heavy%20Industries%20(MHI)%20has%20launched,2024%20to%2031.03.

[10] PIB - https://www.pib.gov.in/PressReleasePage.aspx?PRID=1809037&reg=48&lang=2

[11] PIB - Government measures to increase Ethanol Blending beyond 20% - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2113234&reg=3&lang=2#:~:text=by%20PIB%20Delhi-,The%20National%20Policy%20on%20Biofuels%20%E2%80%93%202018%2C%20as%20amended%20in%202022,oil%20deterioration%20with%20E20%20fuel.

[12] PIB - Government Speed up Ethanol Blending - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2155110&reg=37&lang=1#:~:text=During%20the%20ongoing%20ESY%202024,of%2019.93%25%20has%20been%20achieved.

[13] PIB - Ethanol Blending Boosts Farmer Income - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2159409&reg=3&lang=2#:~:text=19.93%25%20was%20achieved.,To%20support%20ethanol%20production%20across%20the%20country%2C%20the%20Government%20has,renewable%20feedstocks%20including%20crop%20residue.

[14] PIB - Government notified the National Policy on Biofuels to promote the use - https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1777219&reg=3&lang=2#:~:text=Government%20notified%20the%20National%20Policy,by%20making%20them%20cost%20effective.

[15] PIB - Government announces mandatory blending of Compressed Bio-Gas - https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1979705&reg=3&lang=2#:~:text=CBO%20will%20be%20voluntary%20till,companies%20has%20also%20been%20initiated.

[16] PIB - Sustainable Aviation Fuel (SAF) a practical and immediate solution - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2163273&reg=3&lang=2#:~:text=India%20has%20the%20capacity%20to%20meet%20its,2%25%20by%202028%20*%205%25%20by%202030

[17] PIB - National Green Hydrogen Mission - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2039091&reg=3&lang=2#:~:text=The%20Union%20Cabinet%20approved%20the,Public%20awareness%20and%20outreach%20programme.

[18] PIB - Pilot Projects on Hydrogen Fuelled Buses and Trucks - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2107795&reg=3&lang=2

[19] PHDCCI - Press Releases - https://www.phdcci.in/2024/02/13/with-33-states-tier-2-government-urged-to-continue-fame-sch/#:~:text=Newsletter-,With%2033%20States%20&%20UTs%20of%20India%20having%20their%20own%20EV,urged%20to%20continue%20FAME%20scheme

[20] GH_2 India - National Green Hydrogen Mission - https://www.gh2.org.in/green-hydrogen-state-policy

[21] Humans of EV - Five States That Control 41% of India's EV Future - https://humansofev.info/five-states-that-control-41-of-indias-ev-future-september-2025/

[22] GH_2 India - National Green Hydrogen Mission, MNRE, Government of India - https://www.gh2.org.in/green-hydrogen-state-policy

[23] NDTV Automate - Press release - https://www.ndtv.com/auto/delhi-ev-policy-2-0-draft-electric-cars-under-rs-30-lakh-to-get-full-tax-waiver-50-relief-for-strong-hybrids-11346110

[24] Humans of EV - Assam EV policy - https://humansofev.info/assam-ev-policies/

[25] Energetica - Assam Integrated Clean energy policy 2025 - https://www.energetica-india.net/news/assam-integrated-clean-energy-policy-2025-117-gw-re-target-by-2030

[26] Mercom - Assam aims for 11.7GW Renewable Energy Capacity by 2030 - https://www.mercomindia.com/assam-aims-for-11-7-gw-renewable-energy-capacity-by-2030

[27] Powermin - Delhi EV policy 2020 - https://www.powermin.gov.in/sites/default/files/uploads/EV/Delhi.pdf

[28] Invest UP - UP Bio Energy Policy 2022 - https://invest.up.gov.in/bio-energy-enterprises-promotion-programme-2022/#:~:text=UP%20Bio%20Energy%20Policy%202022,Stamp%20duty%20and%20Electricity%20duty.

[29] ICCT: India's transport transformation- https://theicct.org/indias-transport-transformation-three-policies-to-shape-the-road-ahead-sep25/

[30] Niti Aayog - Scenarios towards viksit bharat and net zero - https://www.niti.gov.in/sites/default/files/2026-02/Scenarios-Towards-Viksit-Bharat-and-Net-Zero-Sectoral-Insights-Transport.pdf

[31]Press Information Bureau: Use of Electric Vehicles – https://www.pib.gov.in/PressReleasePage.aspx?PRID=2237556&reg=3&lang=1

[32] Autocar Professional – EV penetration in India – https://www.autocarpro.in/analysis-sales/ev-sales-in-india-surpass-245-million-units-in-fy2026-all-4-segments-register-double-digit-growth-131974

[33] International Energy Agency - https://www.iea.org/commentaries/with-new-export-controls-on-critical-minerals-supply-concentration-risks-become-reality

[34] India data map – 2025 Projections – https://indiadatamap.com/2025/10/08/undertrial-prisoners-by-state-in-india/

[35] Chini Mandi- Distillers eye fresh ethanol investments- https://www.chinimandi.com/distillers-eye-fresh-ethanol-investments-as-industry-awaits-roadmap-for-higher-blending-aida/

[36] Live mint – Govt. says no decision on increasing ethanol blending percentage- https://www.livemint.com/news/india/govt-no-decision-taken-increase-ethanol-blend-beyond-20-pc-ministry-says-programme-saved-rs-1-97-lakh-crore-forex-india-11784803467617.html

[37] PIB- EBP Q&A – https://www.pib.gov.in/PressReleasePage.aspx?PRID=2283118&reg=3&lang=1

[38] Source - Toyota

[39] IBEF - https://www.ibef.org/news/india-aims-to-double-maize-output-to-86-million-tonnes-by-2047-union-minister-for-agriculture-and-farmers-welfare-and-rural-development-mr-shivraj-singh-chouhan

40 Global Agriculture - https://www.global-agriculture.com/ag-tech-research-news/maize-breeding-through-biotechnology-can-boost-yields-by-10-15-in-india-says-iimr/

41 PIB – Circular Economy in Agriculture: Waste to Wealth - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2228963&reg=48&lang=2

[42] Economic times – Grain based ethanol – https://economictimes.indiatimes.com/news/economy/agriculture/grain-based-ethanol-accounts-for-nearly-67-of-supplies-maize-remains-the-largest-feedstock/articleshow/132255561.cms?from=mdr

[43] PIB - Year End Review, MoPNG - https://www.pib.gov.in/PressReleasePage.aspx?PRID=2208694&reg=3&lang=2#:~:text=Under%20the%20SATAT%20initiative%2C%20as,pipeline%20connectivity%20and%20biomass%20aggregation.

[44] USDA - Biofuels Annual - https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Biofuels%20Annual_New%20Delhi_India_IN2025-0031.pdf

[45] PIB - Sustainable Aviation Fuel (SAF) using indigenous feedstock - https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1925417&reg=3&lang=2#:~:text=In%20a%20significant%20development%20towards,special%20flight%20at%20the%20airport.

[46] PIB – Unlocking India's Green Hydrogen Potential – https://www.pib.gov.in/PressReleasePage.aspx?PRID=2189126&reg=3&lang=2

[47] Energy Watch – Govt Initiates Green Hydrogen pilot – https://www.energywatch.in/renewable-energy/green-hydrogen/govt-initiates-green-hydrogen-pilot-projects-including-37-buses-trucks-9-refueling-stations

[48] ICCT – A comparison – https://theicct.org/wp-content/uploads/2024/05/ID-86-%E2%80%93-LCA-HDV-India_final.pdf

[49] NITI Aayog – Scenarios Towards Viksit Bharat and Net Zero - https://www.niti.gov.in/sites/default/files/2026-02/Scenarios-Towards-Viksit-Bharat-and-Net-Zero-%20An-Overview-Vol1.pdf

[50] Digital Sansad – Government of India – https://sansad.in/getFile/annex/270/AU1886_MB3Q0n.pdf?source=pqars

[51] Autocar Professional – India Reroutes – https://www.autocarpro.in/news/india-reroutes-70-of-crude-imports-away-from-hormuz-increasing-from-55-baseline-131590

[52] EIA – China dominates global trade – https://www.eia.gov/todayinenergy/detail.php?id=65305

[53] Chini Mandi – Niti Aayog Report – https://www.chinimandi.com/niti-aayog-report-the-expanding-role-of-biofuels-in-net-zero-scenario/

[54] Niti Aayog- India Electric Mobility Index – https://www.niti.gov.in/sites/default/files/2025-08/India-Electric-Mobility-Index-2024-Report.pdf

[55] Chini Mandi – Ethanol Overcapacity – https://www.chinimandi.com/ethanol-overcapacity-to-persist-for-three-years-as-flex-fuel-vehicle-rollout-stays-gradual-careedge/

[56] Chini Mandi – ESY 2024-25 – https://www.chinimandi.com/esy-2024-25-749-crore-liters-of-ethanol-blended-during-nov-24-july-25/

[57] Chinimandi- Chhattisgarh producing only – https://www.chinimandi.com/chhattisgarh-producing-only-one-third-of-planned-ethanol-capacity-despite-major-investment-push/

[58] New Indian Express – OMCs procure – https://www.newindianexpress.com/business/2026/Jul/20/omcs-procure-2418-crore-litres-of-ethanol-worth-rs172-lakh-crore-in-3-years